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Informal Communication and the Air Force Research and development project manager

Stephen James Bilsbury
The University of Montana

INFORMAL COMMUNICATION AND THE AIR FORCE RESEARCH AND DEVELOPMENT PROJECT MANAGER

By

Stephen J. Bilsbury

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PREFACE

Primary data are based upon the firsthand experience of the author. This experience is the result of six years' duty as an Air Force Research and Development (R&D) Project Manager, including two years at the Air Force Materials Laboratory dealing primarily with basic research projects, and four years at the Air Force Armament Laboratory dealing with applied research. These six years encompassed fifteen projects (five of which were conceived by the author), totalling one and a half million dollars, three patents pending, and a six-month temporary duty tour in Southeast Asia during the Vietnam conflict as the Technical Liaison Officer representing the Air Force Armament Laboratory.

The purpose of this paper is to demonstrate the validity of the stated hypothesis, i.e., the informal communicative function is a vital aspect of Air Force research and development project management. Both the examples and findings will serve as guides for those who are confronted with an assignment to the Air Force Systems Command as a project manager, and for those in civilian industry who would gain some insight into some of the problems which confront the Air Force R&D project manager.

CHAPTER I

INTRODUCTION

The intent of this paper is to show that the informal communicative process is a vital aspect of project management in Air Force research and development (R&D).

Management involves many functions: planning, organization, motivation, control and decision making. In order to properly perform each of these functions, the manager must have adequate and accurate information as his success depends on it.

The Air Force project manager is one who assumes the task of integrating several efforts of different organizations toward the achievement of a particular project. Normally, these efforts are concerned with varied functional groups from extraorganizational activities. Since the project deals with organizations that are primarily extraorganizational and of a functional nature, informal communication, both verbal and face-to-face, is necessary and is the rule rather than the exception. The project manager's responsibilities are diverse. He is expected to be familiar with a myriad of procedures and regulations and to be expert in his particular technical field, as well as in others. The nature of the technical program dictates the manager's responsibilities which, in turn, control his personal contacts, both external and internal, to his organization. The USAF project manager has almost total responsibility for

the conduct of the program which includes the performance of trade-off studies to minimize program cost, and optimize schedule completion and total performance.

Environment of the USAF R&D Project Manager

The shaping of research and development programs to meet national goals is a tremendously complex task. There are, however, direct and important relationships between threat, military objectives, strategy and tactics, weapons systems and national security on the one level, and research and development on the other. The present dominant position of the United States is dependent upon the possession of superior weapon systems, which are products of technology. The decision to proceed with a given technological program or project is based upon a critical two-way flow of information between those in higher authority who establish program goals, and the operating or field personnel who originate or recommend a program that will meet stated technical objectives. The principal task of research sponsored by the Department of Defense therefore, is to support the development of systems and equipment in order to satisfy current requirements and to provide a range of technological options for use in building the future defense technology.

The Air Force concept of research and development differs markedly from that of either the Army or the Navy. The Air Force is unique in the Department of Defense in that it has elected to mix both line military officers who have a technical background, and civilian scientists and engineers. This mix, generally about 40 percent military and 60 percent civilian, provides a fresh stream of new ideas and technical and operational experience to the scientific community, as military personnel are

assigned for three to six years and are then rotated to new assignments in the R&D field. The function of the civilian scientists and engineers is to provide both continuity and background experience, as well as the maintenance of the technical organization and facilities. The Air Force concept of R&D operation is primarily through civilian contractors, resulting in greater flexibility.

The Army and Navy research establishments operate in a different fashion. These organizations consist mostly of civilian engineers and scientists. The few military personnel assigned to these positions perform, for the most part, administrative functions. The rationale here is that the military provide inputs and are strictly users and testers of the developed equipment. In general, they are not required to perform outside their traditional military duties.

The civilian contractor and the Air Force are a temporary team set up to accomplish a specific task. It is imperative that the team members work together as closely as possible, thereby making effective communication between team members mandatory.

Among civilian contractors newly associated with the Department of Defense research and development community through government contracts, there exists a certain amount of misunderstanding concerning the role of the military R&D project manager. This is not surprising. Many of the civilian scientists' relations with the military are based upon their observations of the Army and Navy during World War II or the Korean conflict. These experiences naturally lead them to believe that since they were dealing with a military organization (the Air Force), then communication should flow along the rigid formal lines perscribed by the official organization chart. To be sure, this type of communication does exist;

however, it is not the day-to-day norm. On the contrary, if this were the only kind of communication, then R&D, as currently conducted by the Air Force, would be impossible. Effective informal communication is a vital aspect of R&D project management. It is a method of transferring information in a simple and straightforward manner. It allows the information feedback cycle to occur, and thereby does much to prevent misunderstandings before they occur. Evidently, informal communication plays a major role in the decision maker's acquisition of knowledge. This type of communication is especially appropriate in the management of R&D activities which operate in a rapidly changing technological environment.

The Need for Informal Communication in the R&D Environment

The purpose of a project manager is to serve as a focal point for the task at hand. Unlike the manager of more conventional enterprises who may have several goals to accomplish with relatively fixed resources on a continuing basis, the project manager operates on a discontinuous basis and is concerned with a single goal. The concept of the project manager is based on the idea that modern industrial or technical organizations are so complex as to preclude effective project management using the traditional organizational structures and relationships. Traditional management philosophy is based upon a vertical flow of communication. It emphasizes only a part of the whole and does not place sufficient importance on the interrelationships and integration of activities of the total structure necessary to efficiently manage the project.

As a member of the organization, the project manager is part of the vertical or traditional communications network. This network is

important insofar as it is through this that he receives his authority as well as the tasks to be performed. Paradoxically, it is not through these channels that he accomplishes his primary function, which is to manage a project. The project manager is, by the very nature of his job, a focal point, and as such, he rapidly becomes the center of a Star Communication Network[1] (Figure 1). This network is functional in nature and works on an informal basis. It crosses formal organizational boundaries and exists solely because of the project. The exterior portion of this network may be composed of sales, engineering, and staff personnel from exterior organizations. In the case of an Air Force R&D project manager, one of his informal Star communication networks might look like Figure 2. The formal or traditional organizational network of the project manager might resemble that of Figure 3. A comparison of Figure 2 and Figure 3 reveals why the informal network is so attractive as well as useful. It also becomes apparent that within the formal organization structure, the project manager is isolated from the very people who can help him accomplish his task. This, therefore, is the need, the real reason, for effective informal communication for the USAF R&D project manager. The informal Star network is generated and remains in existence through necessity--a necessity for the simple reason that it would be virtually impossible to accomplish the project on a timely basis by using only the formal communication network.

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[1]Harold J. Leavitt, Managerial Psychology; an Introduction to Individuals, Pairs, and Groups in Organizations, (Chicago, University of Chicago Press, 1964, 2nd Edition), p. 237.

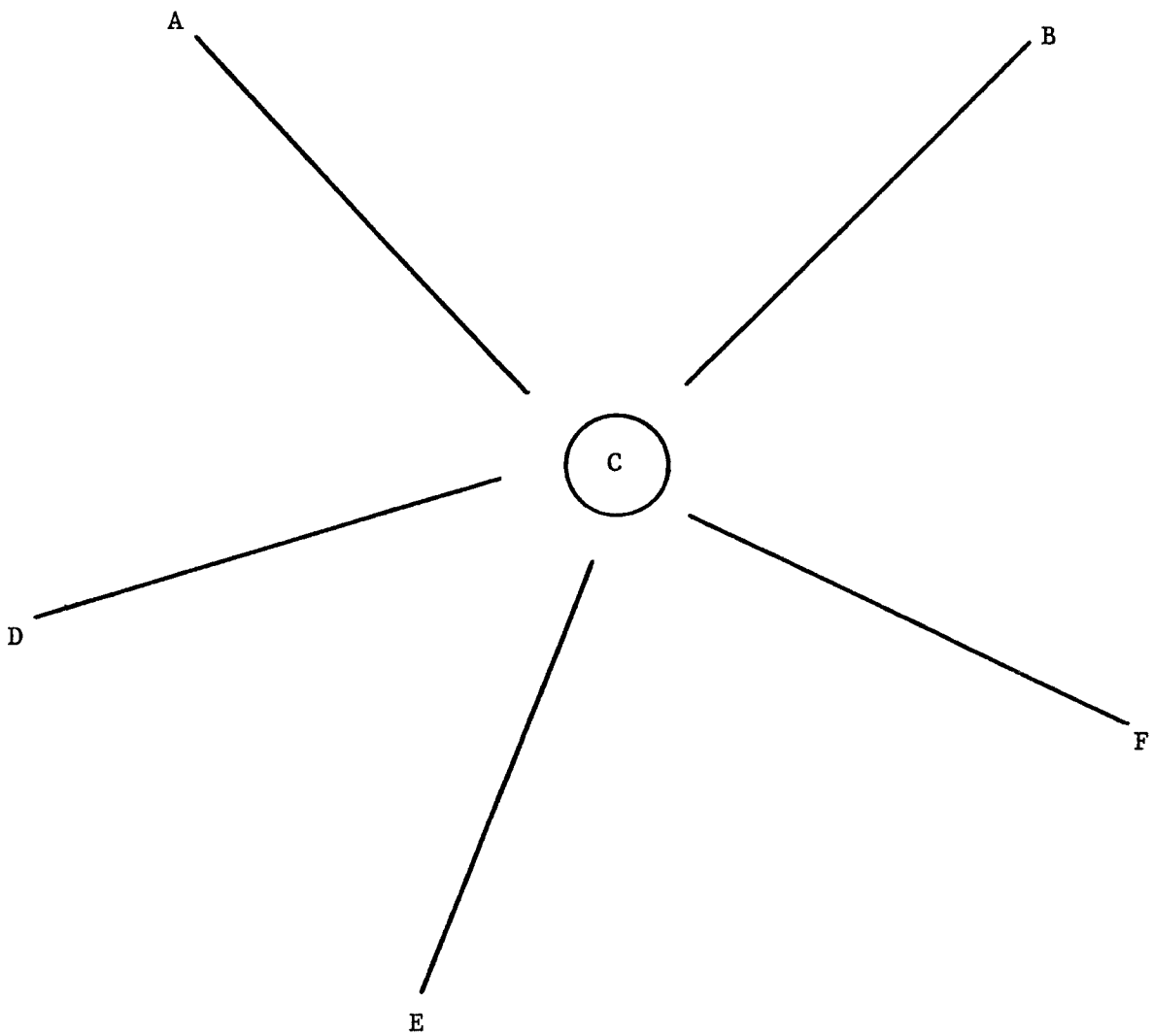

Fig. 1.--Star Communication Network

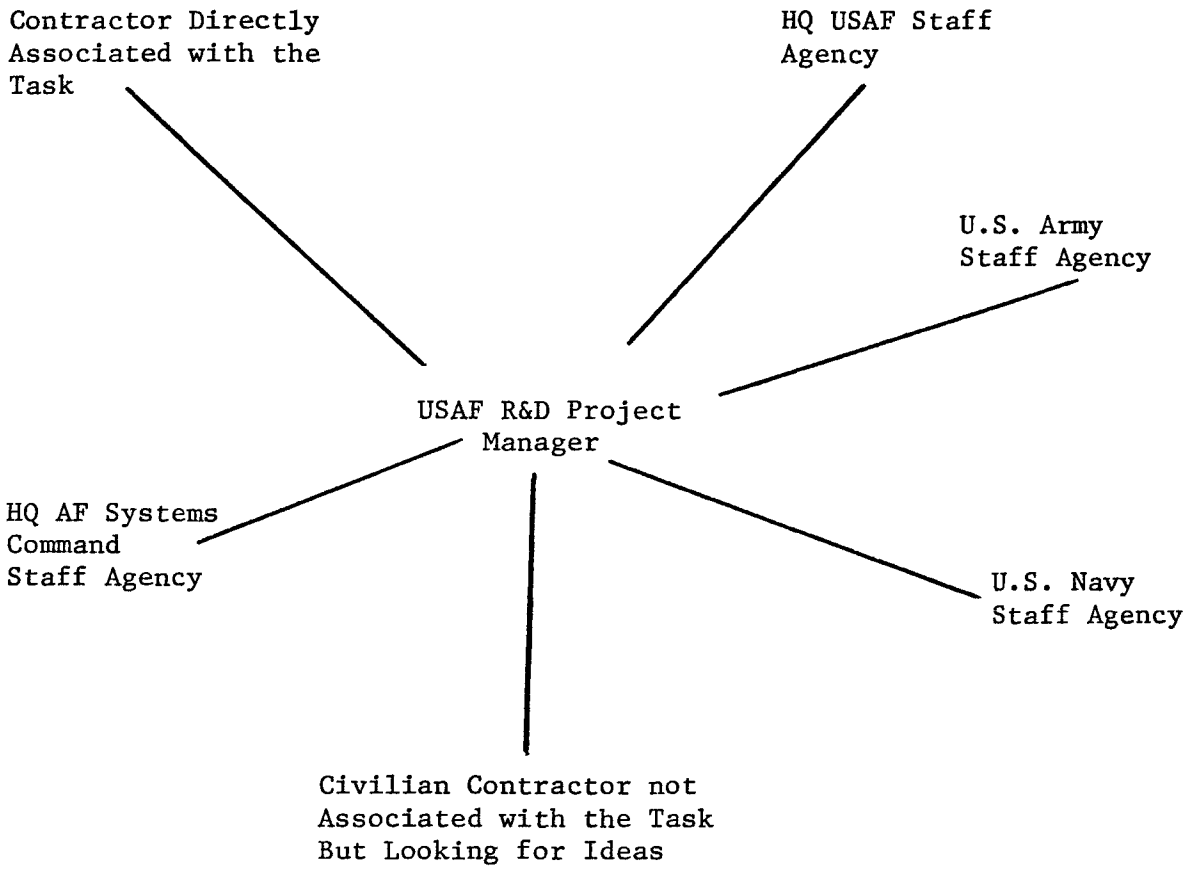

Fig. 2.--Typical Star Communication Network of the USAF R&D Project Manager Depicting Informal Communications Channels

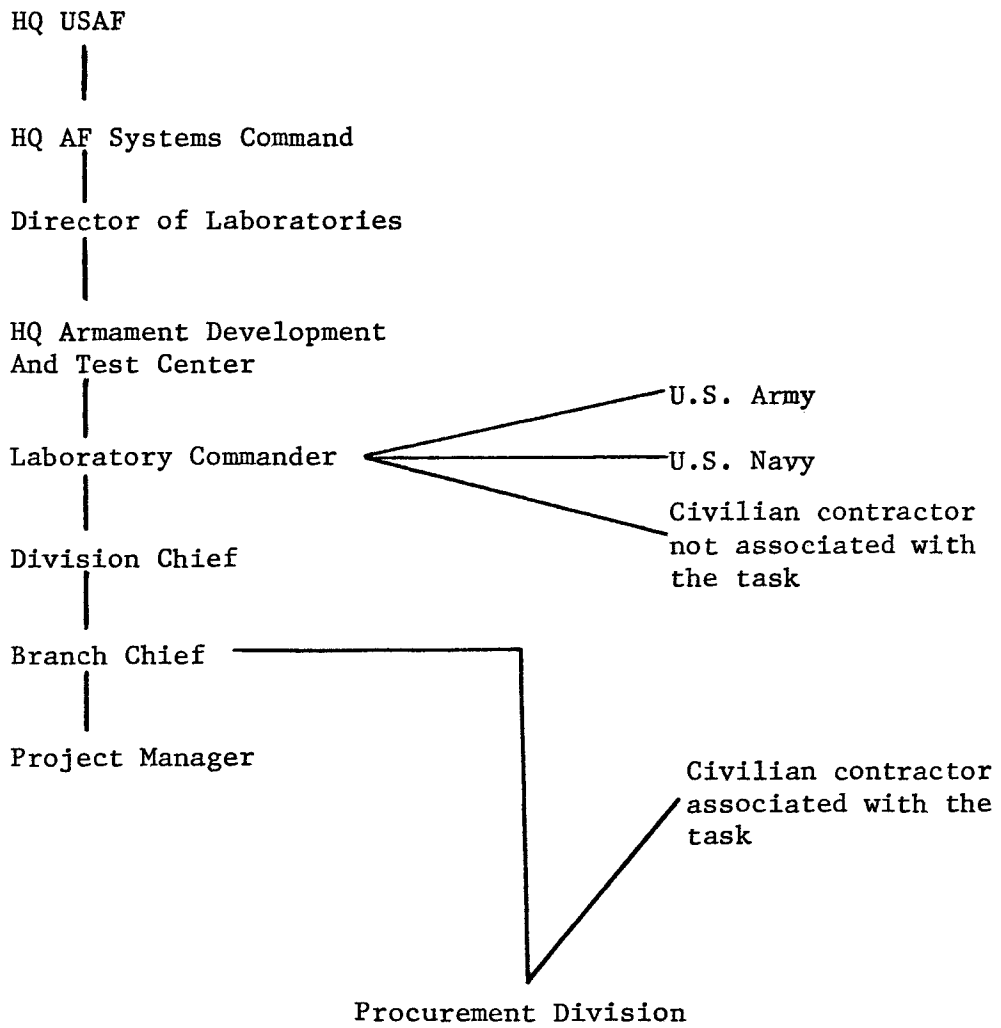

Fig. 3.--Traditional (Vertical) Organizational Structure
Depicting Formal Communications Channels

Evolution of the Project Manager Concept within the USAF

The project manager concept in the Department of Defense arose naturally as a result of a perceived need. It arose as a result of individuals being charged with responsibilities for achieving results, but having little or no authority over those having the capability of making the project successful. The project manager evolved from the need to rise above the massive bureaucracy of the Department of Defense and the need to communicate with those who could bring the task to completion. The management of research and development projects is a discrete, complex and demanding task. The R&D project has all the elements of an enterprise which is conceived and built within a definite time span. Rarely does the manager find that project activities are limited to his own organization; he usually works with people outside of the organization. As a result, he becomes a source of integrated information concerning his particular project and an interaction point for coordinating the diverse organizational and extraorganizational activities involved. It is this central communicative function which enables him to exercise control over the project.

The concept of the project manager was created within the existing functional structure of an Air Force laboratory. The resulting matrix organization thus created authority, responsibility and communication networks. It allowed a complex task to be economically performed without upsetting the existing functional alignment of the laboratory.

Project managers are not new; however, as a result of the massive technological boom since the late 1950's, the concept of the project

manager as an organizational entity is becoming recognized by industry. This recognition resulted in the appointment of a civilian contractor counterpart for the government project manager.

Historical Precedent

A French industrialist, Henri Fayol, was one of the first persons to formally recognize that there was a requirement for other than vertical communication within an organization. In 1916, Fayol developed the idea that cross-communication, i.e., the transmission of information from one point in a vertical organization chain to another point in a different vertical chain, was not only appropriate but necessary. This was especially true for those near the bottom of the vertical organizational ladder. He created what is now called Fayol's Bridge (Figure 4) to depict the situation. Fayol postulated that it was a waste of time for F to communicate with E by proceeding step by step up the long vertical organization chain to A, then down the other chain to E. This postulation was subject to two preconditions. The first was that organizational policy allows certain types of cross-communication to occur, and second, that each communicator keep his superior informed as to any significant results of the action.[2] Although Fayol's book was not published in the United States until 1949, his ideas spread. During World War II, specific management groups were set up to deliberately cut across long vertical functional organizations. These were called task forces. They operated successfully in many theatres of the war, and were the apparent forerunners of the current project manager type organization.

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[2]Keith Davis, Human Relations at Work: The Dynamics of Organizational Behavior, (New York, McGraw-Hill, 1967, 3rd Edition), p. 346.

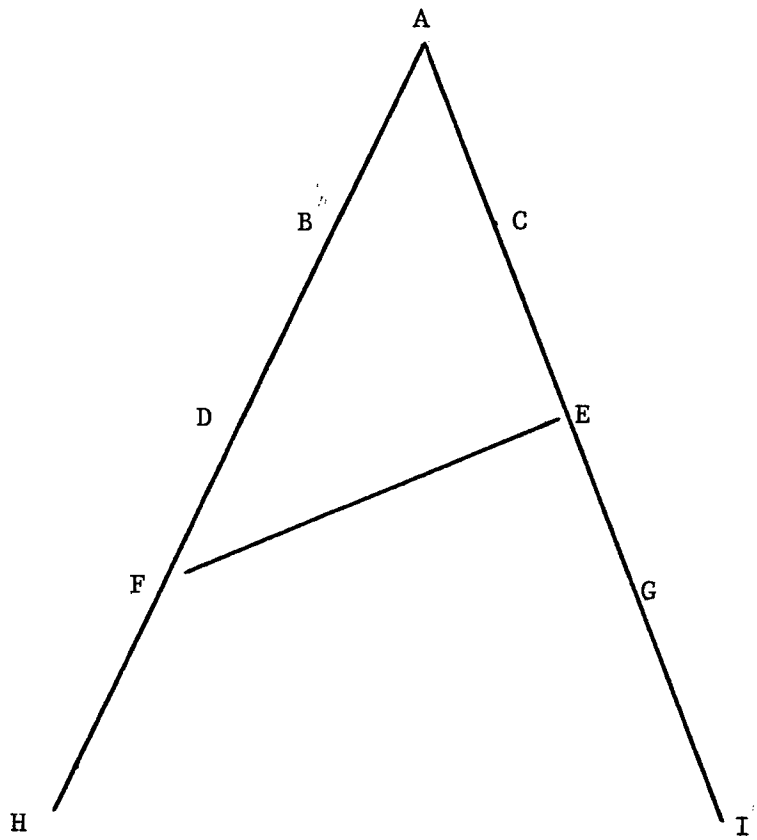

Fig. 4.--Fayol's Bridge

CHAPTER II

FACTORS AND APPROACHES TO EFFECTIVE INFORMAL COMMUNICATIONS

Factors Involved

Communication is a process of information transfer that takes place by means of some sort of network arrangement. Douglas McGregor described the process of communication as follows:

> It is a process of mutual influence. If the communicator begins with the conviction that his position is right and must prevail the process is not transactional but coercive. The process is one-way no matter how many words may be said by those receiving the communication. Even if it takes place in a face to face situation it is as much one-way as mass-media advertising.[3]

There are other definitions as well. Goyer states, ". . . to share meaning, is to share experience, which is to communicate."[4] Charles Redding describes it as, ". . . a brief working definition of communication: 'The process of sending and receiving messages.'"[5]

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[3]Douglas McGregor, The Professional Manager (New York: McGraw-Hill, 1967), p. 153.

[4]Robert S. Goyer, "Communication, Communicative Process Meaning: Toward a Unified Theory," The Journal of Communications, Vol. 20 (March 1970), p. 15.

[5]W. Charles Redding, "The Organizational Communicator," Business and Industrial Communication, a Source Book (New York: Harper and Row, 1964), p. 30.

The majority of the project manager's communication is verbal and usually of an informal nature. It is a generally accepted fact that most people retain only about twenty-five percent[6] of what they hear. This percentage is of course dependent upon certain factors; the particular person's memory curve, his degree of interest, how much the message has been reinforced by repetition or association, his perception of its content and importance, and the attitude of the recipient toward the speaker.

Communication networks are the paths that messages follow. These paths vary with the changes in the organizational structure and the positions of the transmitter and receiver in the structure. Along these networks, there exist various kinds of information flow. All organizations are stratified, and channels cutting across these responsibility strata are set up to provide orderly communication which is intended, in theory, to place relevant information before those who require it. These channels normally conform to the organizational network and are the means by which most messages are passed. This is called formal vertical communication, as it flows along formal organizational responsibility channels.

Another type of communication flow is along the "grapevine." This is a nonstructured flow of miscellaneous information of interest. It respects no boundaries and is as fortuitous as its message content is unauthenticated.

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[6]T. M. Higham, "Basic Psychological Factors in Communication," S. G. Huneryager and I. L. Heckmann, Human Relations in Management, (Chicago: Southwestern Publishing Co., 1967, 2nd Edition), p. 546.

Analogous to the "grapevine" information is the concept of informal job-related cross-communication. This type of flow is differentiated by the criterion of information which is relevant to the project.

Formal lateral communication is where job-related liaisons are clearly delineated by functional organization policy or by the manager's superiors. The basic premise behind this form is group effort, i.e., the pooling of different skills in order to achieve a goal.

The project manager uses all of these types of communication patterns, as each of them is valuable under particular circumstances. Personal experience, deductive reasoning and subjective judgement, coupled with help from the literature on management, have permitted the identification of several key factors which appear to be basic to effective informal communication for the R&D project manager. There are other factors extant as well, but for the program manager, the following appear to be essential.

Trust

The most important criterion for effective communication is trust. Prior to any real or effective communication, trust in a given amount which varies between individuals and situations, must exist between the project manager and the person with whom he is communicating.

Douglas McGregor has given one of the best definitions of trust used in the context of executive communication. He states:

> Trust means: "I know that you will not deliberately or accidentally, consciously or unconsciously--take unfair advantage of me." It means: "I can put my situation at the moment, my status and self-esteem in this group, our relationship, my job my career, even my life, in your hands with complete confidence."[7]

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[7]McGregor, The Professional Manager, p. 163.

McGregor may be idealistic but he is also a pragmatist. He goes on to say:

> The variable (trust) is dysfunctional at the extremes; again most managerial groups operate in a range well below the appropriate level; again, the form of organization (particularly the stress in individual competition) affects the degree of trust that is practical.
>
> Trust is a delicate property of human relationships. It is influenced far more by actions than by words. It takes a long time to build but it can be destroyed very quickly. Even a single action--perhaps misunderstood--can have powerful negative effects. It is the perception of the other person and of his actions, not the objective reality, on which trust is based. And such perceptions are profoundly influenced by emotions: needs, anxieties, guilts, expectations, hope.[8]

Stated in simpler terms, trust is the degree of confidence one person has in another. This becomes of paramount importance when one remembers the formal communication chain of the Air Force R&D project manager (Figure 3). In order to achieve his objectives in a timely manner, the people he works with and for must take him literally at his spoken word. Normally, decisions are made and actions are taken as a result of a simple telephone conversation. If all the people the project manager interacted with waited for formal written confirmation of everything the project manager agreed to, then things would move slowly indeed.

Interest

In the Air Force Systems Command research laboratories, exceptional pains are taken by personnel managers and commanders to assure themselves that the project managers working within the laboratory are placed in an environment that is of interest to them. Indeed, an officer

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[8] Ibid.

may select his own area of work and take up to three months to do so. The Air Force believes that the project manager's effectiveness depends upon his interest; the degree of interest is also extremely important to the informal communicative process for two reasons.

First, it affects one's memory in a positive fashion. The higher one's interest in a given subject, the more one remembers. As a result, one becomes more confident, willing, and better able to communicate informally.

An illustration of the importance of interest in informal communication is given by T. M. Higham who relates a story about himself, his students and an experiment demonstrating the unreliability of chain communication. One of the stories which passed through the chain concerned a professor, his students and forthcoming examinations. Professor Higham relates:

> To my surprise, I found that reproductions of the story showed few changes and comparatively small loss of detail, whereas all the other stories produced many changes and a great loss of content with successive reproduction. Applying an appropriate statistical technique, I found that such a result was unlikely to have happened by chance. The explanation was that the students were personally involved in the story: it was about something that affected their interests: and for all they knew, it might have been true, or a prophetic warning! Because of this personal interest, they remembered it better. . . . People will show most interest in things which concern them personally, or which are linked to their basic needs.[9]

The second reason that interest is important to the informal communicative function is that when interest itself is communicated, it intrinsically generates, and becomes the basis of, new acquaintances

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[9]Higham, "Basic Psychological Factors in Communication," Human Relations in Management, p. 538.

or professional contacts. These contacts are people whom the project manager meets during his personal interactions in the performance of his duties. All contacts are not necessarily amenable to effective informal communication. They occur both by design and by chance. They are necessary to the project manager in the accomplishment of his objectives. Elton Reeves confirmed this point:

> A little reflection will show that there are several permutations of different levels of relationships which occur in a manager's liaison work. He has many contacts with his direct peers in the hierarchy--these will probably comprise a majority. But he will also have many meetings and do much work, with others at both higher and lower levels in the organization. It is here, in the whole area of this coordinating work, that today's manager will find continuously the most rigorous testing of his abilities in interpersonal relationships.[10]

Mobility

Mobility is important to the R&D project manager as it allows him to obtain information at, or very near, its source. The reliability of the information therefore is increased since it is easily verified at this point; but of more importance is that this mobility is necessary in order to achieve face-to-face communication, allowing feedback to occur most easily. This type of information flow is extremely necessary because of the complex information exchange that must of necessity occur if the project is to be successful.

Norman B. Sigband discusses the topics of feedback and face-to-face communication:

> The popular meaning for feedback is the verbal or non-verbal response received from the individual to whom a message is directed. It may be a series of words; it may

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[10]Elton T. Reeves, Management Development for the Line Manager, (American Management Association, Inc., 1969), p. 24.

> be a raised eyebrow, and angry expression, or a smile; it may be no response at all (which is a response indicating that the message was not heard, not understood, or not accepted). But it is only through the feedback we receive that we can know whether we have communicated our ideas.[11]

Feedback, in addition to providing better message understanding, provides a lead-in for pertinent unsolicited information.

Mobility broadens the scope of the project manager's view. Meeting and talking with people of different backgrounds and areas of expertise allows him to increase his knowledge, as well as his confidence and his ability to communicate effectively.

Pragmatic Approach

A practical approach to the subject of informal communication for the USAF R&D project manager has been examined and illustrated. The ensuing comments and recommendations are the results of personal experience. The concept of the project manager operating in a separate yet attached environment, which is superimposed on the functional organization, is still quite new to many people. As a result, many supervisors are not sure how to effectively manage a project manager. Accordingly, the operating conditions of each project manager vary somewhat with the personalities of their respective supervisors. These variable conditions are what prompted this approach. The charter of the project manager is to achieve success, but the means to do so, within limits, are largely at his discretion.

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[11]Norman B. Sigband, Communication for Management, (Glenview, Illinois: Scott-Foresman, 1969), p. 17.

Environment

The organization of the project manager is one that is superimposed upon the basic functional organization. The purpose of this organization is essentially a transient one, and, as such, presents both problems and opportunities for the project manager. Since project personnel normally derive from the functional organization, they remain susceptible to its environment; for example, these people realize that the project is of a relatively short duration (two to four years). Unless unusual circumstances occur, they will revert to the functional organization once the project is completed. The undesirable features of this transience are immediately discernible. Lack of control is the most important. According to Maslow, security is basic to most people's wants and needs. Project personnel must be assured of reward should the project be successful and be assured of tenure should it prove unsuccessful, as lack of success is more often the case than success. It should be understood that government research and development efforts have different goals and purposes than those of civilian enterprises. Considering these different goals, a project is often undertaken which goes beyond the technological frontiers of the state-of-the-art. Private enterprise cannot long exist in this environment because the failure rate is high, and personnel and equipment are expensive. Yet, in the Department of Defense certain technical needs exist, and these must be satisfied or alternatives devised.

While not always apparent, there are desirable aspects or opportunities in the transient project organization. It seems to attract those people who prefer to operate in a nonconventional manner. They

are willing to lose their place in the functional organization for an opportunity to progress at a more rapid rate in the project organization. These people tend to generate informal communicative contacts more easily and more often than do those who operate in a more conventional atmosphere. Another advantage of the project organization is its permissive environment. Because of the short duration of the project, few directives concerning its operation have been formulated. What few exist are normally of a very general nature. It is here that the ideal environment for a purposeful, effective, informal communications network exists. This network springs into being for two reasons: first, the project has a single goal, and second, the organization is essentially unstructured.

Individual Style

There probably exist as many different types of project organizations as there are project managers. Each organization is an extension of the manager's personal style. The R&D project manager can reap the most benefits through encouragement by personal example of effective informal communicative practices. One of the most effective ways is to simply let others know what is going on in the project. Much of this is directed in any case by the functional organization. There are, nevertheless, many opportunities to personally initiate a dissertation concerning the project, its purpose, accomplishments and requirements, both formally and informally, to people in other related areas. This course of action has the advantage of keeping those who have a need-to-know (as well as those who think they have a need-to-know) informed. It is an advantage to keep the latter informed because by so doing one can

occasionally obtain pertinent unsolicited information which otherwise might have been unknown or unobtainable. There are obvious disadvantages to this course of action, among them, for example, time required for presentations and unwarranted meddling by members of the functional organization; but in the author's opinion and experience, it can be well worth the effort. Informal communication is a give-and-take affair. Unless another person realizes that one is genuinely interested and involved in getting a problem solved, there is a good chance that he will not exert much effort to help. This is where personal contact excels as a means of placing oneself in a position to obtain pertinent unsolicited information. Since communication is a process of giving as well as receiving, it behooves the project manager to pass on unsolicited information which he believes to be pertinent whenever possible and appropriate.

CHAPTER III

SITUATION EXAMPLES AND ANALYSIS

Wartime Situation Environment

Effective communication in a large organization is difficult to achieve. The Air Force, for all of its expensive and sophisticated communication equipment and facilities, is no exception. It is generally accepted that the fewer the links in a communication chain, i.e., the number of people that a message must pass through, the better the communication. Communication in this case is defined as better understanding with more feedback between the parties involved, a generalization that has long been recognized.

When the Air Force entered the Vietnam conflict, it quickly became apparent that there were very few weapons available which were suitable for the type of conflict in which it found itself engaged. As a result, the Air Force was confined to using World War II conventional weapons on aircraft designed for nuclear warfare. Needless to say, the two were not very compatible. Because of this, many crash weapon development projects were initiated in an effort to alleviate this untenable situation. These weapons did not always perform as designed. Fuzes did not work, bombs failed to function, guns jammed, and other deficiencies occured for one reason or another. Because of these deficiencies, our casualty rate, as well as the cost of eliminating a target, rose to very high levels.

The normal military communication chain from the user to the developer is made up of many links (people). There is an emergency system of communication for reporting unsatisfactory equipment which bypasses the normal communication chain. Unfortunately, this system exists only for equipment that has been accepted by the Logistics Command for worldwide use and is an inventory item. It does not apply to new items in limited use. Before an item becomes a part of the USAF inventory, it must undergo extensive, expensive, and time-consuming testing. Neither the time nor the money were then available.

The normal communication chain often had as many as twelve links (Figure 5) between the user and the developer. In many cases (and for many reasons), information concerning a deficiency in a new weapon was never allowed to get off the base where it was being used.

Information feedback on new products was essential to their development, especially when adequate time had not been available for intensive testing. This situation was identified early in the war. As a result, the Air Force Systems Command developed and implemented the idea of using a liaison officer to reduce the number of communication links and speed up the feedback process. This arrangement was made in addition to the normal communicative process. The liaison officer (Detachment Air Force Systems Command - DAFSC) had the authority to communicate directly with whoever could or would alleviate a perceived problem. In most cases, the person to clear up the problem was the project manager of the weapon involved. Communications were on an informal basis, mentioned no names, and provided a valuable feedback link both to the project manager and to the actual user.

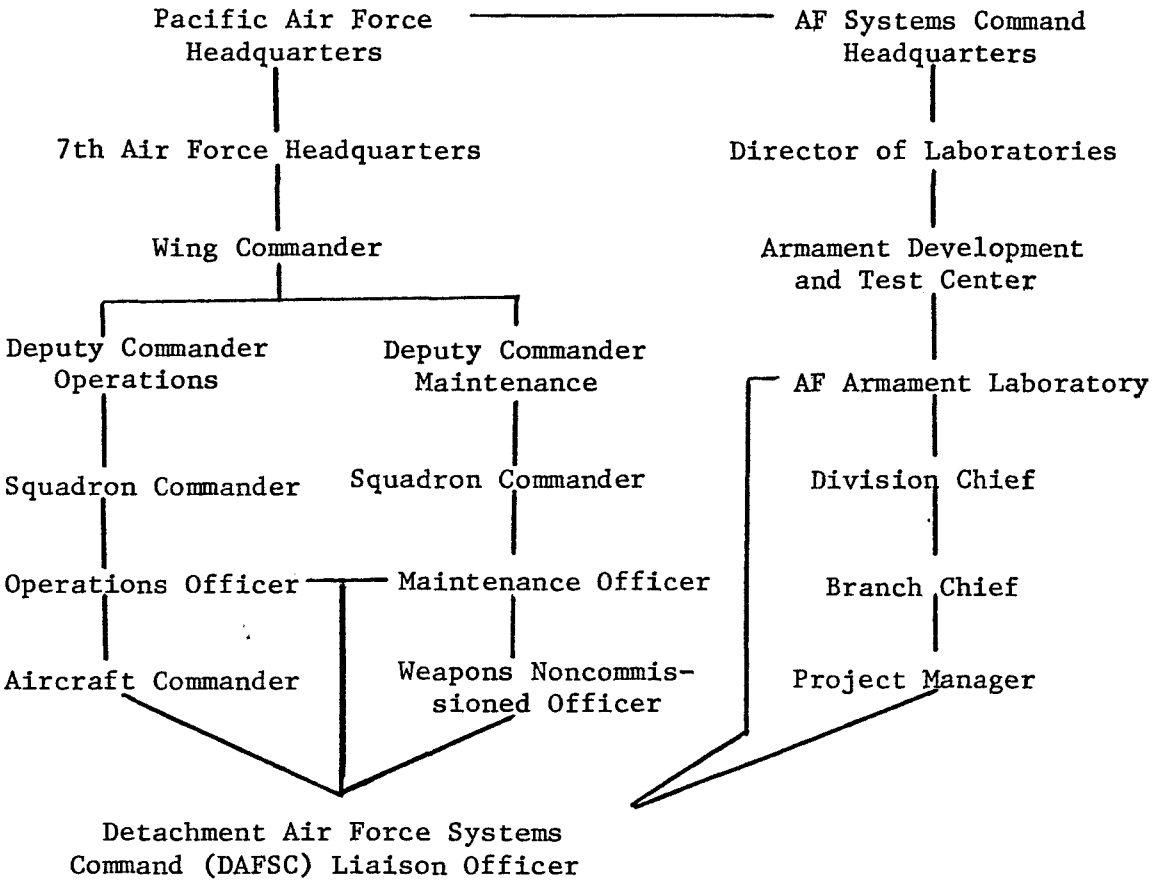

Fig. 5.--Long Communication Chain and DAFSC Link

This informal liaison network had many advantages. It was very fast. In some instances, information was passed via transpacific telephone with an operational priority, although it was more usual to use teletype facilities. Another advantage of the information obtained by informal liaison was its remarkable degree of veracity. This information was usually exchanged in informal surroundings, often by chance, and on a private, person-to-person basis. Much of the information thus obtained, although highly subjective, proved to be valuable when transmitted to the weapon project manager. Jack R. Gibb states:

> There is some evidence that communication is best when it is in response to natural interaction on the job between people who are learning appropriate trust, when it is in small groups or face to face situations, when it is asked for, and when it is between members who do not have too great psychological or hierarchical distance. The most effective communication thus tends to arise spontaneously out of situational demands.[12]

The development of new products is based upon assumptions. The success of a product is therefore dependent upon the validity of these assumptions. As the product is developed, tests are normally conducted to eliminate the assumptions on a logical, orderly basis prior to its introduction to the user. In the case of the Vietnam conflict, many of the "new products" were developed without adequate testing because there simply was not enough time. When a new weapon was introduced, a special team of experts was brought to the operational unit to brief and assist the users. The team also sought to obtain useful information concerning weapon performance and suggestions for improvement.

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[12]Jack R. Gibb, "Communication and Productivity," S. G. Huneryager and I. L. Heckmann, Human Relations in Management (Chicago: Southwestern Publishing Co., 1967, 2nd Edition), p. 524.

This special introduction team was a one-time occurrence. The personal contacts made were generally of a brief and of a public and formal nature. As a consequence, meaningful feedback was limited and incomplete.

The users, in turn, appointed selected crews for the introduction, in order to minimize the chances of anything going awry. The total introduction lasted several weeks, at the end of which the team departed the combat zone. The selected crews went back to normal duties and the weapon was put to use by other crews. Useful information derived from formal reports concerning the weapon's usability and effectiveness was difficult for the project manager to obtain since operations reports are terse.

BLU-42 Mine

The BLU-42, better known by the acronym WAAPM, Wide Area Anti-Personnel Mine, was a new type of mine designed to be sown by aircraft. The design of the mine was such that, on impact with the ground, trip wires deployed from the munition, and an electrolytic battery began operating. The life of the battery was a nominal 48 hours; when the charge decayed below a certain level, the mine destroyed itself. Electrical output from a battery was the result of a chemical reaction. The rate of chemical reactions of this type is temperature dependent. A basic assumption, therefore, was an average temperature. Since Vietnam is located near the equator where the average temperature is 90°F, the batteries were designed to operate in this environment.

Problem Causes

These mines were dropped to form temporary barriers which would prevent the Army from being infiltrated. Vietnam was a fluid conflict

rather than one characterized by stationary fronts. When these mines were dropped in the Vietnam Highlands, where temperatures drop to 40°F at night, the batteries lasted considerably longer than planned--in some cases, they lasted as long as six months. Because these mines failed to self destruct on schedule, large areas of land were denied to friendly troops as well as the enemy. As a result, the Vietnamese Army stopped calling for this munition and the demand for it in the field all but ceased. Meanwhile, back in the United States, a data package had been developed, and production was underway on a large-scale crash basis.

Problem Resolution

Information concerning the mine's unexpected longevity was obtained by a DAFSC representative from a U.S. Army field unit, co-located with a Vietnamese Army headquarters. These data were transferred to the munition project manager, and production on the new units was stopped. The units already produced were shipped, and targeting officers were briefed on where this munition could be dropped. (It could be used in the lowlands where the temperature did not fluctuate.) A re-education program was begun among the Vietnamese Army. As confidence in the munition built up once again, demand increased; however, production did not resume and the usage rate never again reached previous high levels.

In this case, all of the information was available at the outset. The basic assumptions were wrong and the right people failed to ask the right questions. The situation was partially saved when a liaison officer fortuitously obtained pertinent information and the knowledge and had the means and opportunity to expiditiously contact the correct people.

AC-130 Gunship

The AC-130 is a second generation gunship. The gunship is a transport aircraft equipped with side-firing automatic cannons. When the aircraft flies a pylon turn, the guns remain pointed at a constant point on the ground. This enables the aircraft to concentrate a tremendous amount of highly accurate firepower upon a single target. The first generation gunship was a modified C-47 World War II transport equipped with .50 caliber machine guns. The AC-130 is a much larger and more powerful aircraft. At the time of the investigation referred to here, it was equipped with a 20mm Gatling gun and two 40mm Bofors cannons. The Bofors cannons were World War II cannons developed by the Navy for ship air defense. These guns were selected for the AC-130 because both guns and ammunition were avilable from World War II residue, and they were accurate over a long range. Two or three shots were all that were necessary in order to hit a ground target at night from a 15,000 foot altitude.

Problem Causes

As a World War II anti-aircraft cannon, the Bofors 40mm ammunition had been out of production for many years. The AC-130 weapon system had been in use for several years. Informal conversation between the munitions maintenance officer and the DAFSC representative revealed that although 40mm ammunition was being shipped in the requisite quantities, it was made up of a great number of mixed lots; i.e., one shipment of ten thousand rounds sometimes had as many as two hundred lots. Ammunition ballistics are consistent within the same lot but vary considerably

from lot to lot. Thus, a projectile fired from one lot will not hit in the same place as a projectile fired from another lot. The difference between them is small, but the target was a truck five feet wide by fifteen feet long viewed from a 15,000 foot altitude.

Problem Resolution

This information was immediately transmitted to the project manager in the United States, who in turn laid specific requirements on the Navy which had charge of the ammunition. The problem was perceived by the DAFSC representative who had contacted the munitions maintenance officer on another matter. It was during the ensuing conversation that the topic of mixed ammunition lots had come up. This topic was completely fortuitous. Had the situation continued, the effectiveness of this novel weapon system would have suffered severely.

Peacetime Situation Environment

Just as the wartime environment of the project manager is fluid, the peacetime environment is relatively static. With this organizational stability, personal ties and contacts, once established, tend to remain. These informal sources of information are extremely valuable to the project manager and can be of paramount importance to the project. In some cases, advance information from these sources can determine the project's success or failure.

For the most part, informal information, by its very nature, frequently consists of "noise," i.e., information which is nonessential and nonpertinent to the project. The project manager, because of his position of responsibility at the center of a Star communication network,

is likely to receive a great deal of "noise." He cannot escape it. If he attempts to install a "filter" to screen out the "noise," then the "filter" will become the center of the network. Harold Leavitt, in his discussion of communication networks, observes:

> Preferential access to information, after all, is a major source of power in any organization. In experiments in the Star network [Figure 1], any man in the central position, C, is likely to become the functioning boss. His personal characteristics do not matter much. He learns more, faster, than anyone else.[13]

It appears necessary, therefore, for a successful project manager to listen to a certain amount of "noise." In some cases, this "noise" is another person's method of sending out communicative feelers in order to determine how receptive the potential receiver might be. Exercising a degree of patience occasionally results in nonproductive effort, but more often than not, the manager's effort is repaid in time and materials saved, and future goodwill and cooperation engendered. This approach pays off in a flow of unsolicited information which may, or may not, be pertinent at that point in time. This flow is partially controllable by the degree of accessibility of the manager to other associates, and how much they want to communicate with him. The degree of pertinency of the information flow may be dictated to the extent that others are aware of the project manager's interests, and that his interests coincide with their own. Gerald Albaum, in his study of the flow of pertinent unsolicited information among executives,[14] defines this information as: "Information which may in fact

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[13]Leavitt, Managerial Psychology; an Introduction to Individuals, Pairs, and Groups in Organizations, p. 237.

[14]Gerald Albaum, "Horizontal Information Flow: An Exploratory Study," Academy of Management Journal, (March 1964), pp. 21-33.

exist or be obtainable but which potential users do not know is available unless they happen to chance upon it."[15]

Albaum suggests that this type of information can be attributed to at least two factors: "(1) the interaction patterns between potential receivers and transmitters of information, and (2) the organizational structure within which the information activity is performed."[16] Albaum goes on to suggest that perhaps a centralized information system may be a panacea.

Plastic Rotating Bands

A rotating band is that part of a steel projectile which deforms upon engagement with the lands and grooves on the interior of a gun barrel and, as a result, spins up the projectile. In the past, the rotating band had been made of copper. The Air Force required a projectile that would not wear out gun barrels under high-rate firing conditions (7,000 shots per minute) and which would allow higher velocities (4,400 feet per second).

Problem Causes

The plastic band was a new exploratory development effort. Computerized literature searches had been accomplished, but yielded little usable data. A major area of concern was the expected storage life of the band and its reliability. A long-term storage life of twenty years was required. Accelerated aging tests exist for many polymeric materials; however, the results of these tests are often open to dispute. Notwithstanding the lack of information, the Air Force solicited bids from

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[15] Ibid., p. 22.

[16] Ibid., p. 30.

private industry, the proposals were evaluated, and a contract to develop these bands was let.

Problem Resolution

The laboratory had previously implemented a weekly activity report. Its purpose was to broaden the scope of knowledge of laboratory personnel and perhaps engender some cross-fertilization where applicable. A routine report on the progress of the plastic band project was therefore generated. As a result of the inclusion of this report in the weekly activity summary, the project manager received a call from another person whose activities and work were in another part of the laboratory and completely divorced from those of the project manager. The person who called had retired from the Navy. He remembered similar research on plastic bands being carried out nearly twenty years earlier! Calls were made, people located, and a trip for the project manager was planned. Upon his return from the Naval installation, he brought with him a wealth of unpublished data, as well as several hundred projectiles with plastic rotating bands! Due to a change in weapon priorities and consequent funding cuts, the Navy had dropped the program just prior to running operational tests on it. With the onset of the Vietnam conflict, ammunition and gun changes were made in Navy aircraft, and the program had never been resumed. These old projectiles provided the answers to a variety of questions, the most important of which was its behavior at high velocity after twenty years' storage. The plastic rotating band passed testing under rigorous conditions and did much to increase confidence in the concept. The design was copied and is being used in a large ammunition program, and

has saved the government thousands of dollars in testing and development costs.

Without this unsolicited information transfer, it is doubtful that these savings could have been realized. This information had another effect: it changed the orientation of the funded plastic band project, and resulted in a totally new kind of rotating band and a new concept in projectile design.

Plastic Frangible Projectile

The plastic frangible projectile was a new concept and design. The object of the development project was to prove the feasibility of the idea. If the concept were possible, then a less expensive projectile that broke up on impact with the target could be made. A projectile with these properties was desirable as it would eliminate long ricochets and projectile/aircraft collisions which occurred during routine practice strafing runs. The new projectile consisted of a column of steel platelets inside a plastic jacket.

This development effort took place concurrently with development of the plastic mischmetal projectile. The latter was an incendiary projectile which used the same plastic jacket as the frangible projectile. The core material was mischmetal (a mixture of rare earth metals, the same as is used in lighter "flints"). On impact, this projectile burst into burning fragments with a high degree of persistence.

Problem Causes

The plastic mischmetal projectile project was moving on schedule toward a successful conclusion. This was not the case, however, for

the frangible projectile. Serious problems had developed; both time and money were running short and the projectile had not yet achieved design velocity without breaking up inside the gun barrel. Neither flash x-ray pictures taken of the projectile in flight at the muzzle of the gun, nor projectile fragments, provided any clues as to the probable cause of the early breakup. The whole development effort was threatened with failure.

Problem Resolution

The contractor for the plastic mischmetal round was separated geographically be several thousand miles from the contractor for the frangible round. During the informal session that ensued, a design review of the mischmetal projectile at the plant facility, the fate of the frangible projectile was discussed. This discussion included pertinent data, as well as methods devised to determine the cause of failure. The following day consisted of a brief meeting to wind up the details of the issues decided upon during the previous day's meeting. During the coffee break, one of the engineers mentioned in passing that he had run an inside micrometer down the interior length of the plastic jacket and had found a depression under the thicker wall portion caused by the integrally molded rotating band. He didn't understand the reason for it but the Air Force project manager did. It was a normal sink mark caused by the thicker rotating band section. It should have been eliminated by proper mold design. This bit of unsolicited information provided the clue that solved the frangible projectile breakup problem. During projectile spinup in the gun barrel, the steel washers had shifted sideways into the sink mark which in turn caused an eccentric

mass imbalance that resulted in catastrophic failure at the muzzle. The elimination of this sink mark, a simple machining operation of the plastic mold, resulted in a projectile that flew intact until it reached the target. The project was a success. It was estimated that this development alone would provide the United States Government with a saving of millions of dollars in projectile costs and aircraft repair and replacement costs.

CHAPTER IV

CONCLUSIONS

Summery of Findings

The concept of the Air Force R&D project manager is still very new; so too are the concepts of communication, both informal and formal, which relate to this peculiar management function. The project manager exists in a rapidly changing technological environment. The far-reaching ramifications of one technical development on another apparently unrelated technology can have far reaching effects upon the project manager's task. It is imperative that he have a competent grasp of those developments which could affect his task. To keep abreast of these developments as they occur, it is necessary for him to develop a good informal communications network.

There appear to be several common factors which are needed for effective, pertinent informal communication. These factors, i.e., trust, interest, and mobility, have been isolated by authorities in management as being a prerequisite for effective communication. The concept of the project manager is a pragmatic rather than a theoretical approach to accomplishing a task quickly and economically within the confines of a massive bureaucratic establishment, such as exists in the Department of Defense. The project manager conceives or is given a task to accomplish. As an individual with little guidance, he develops his own

managerial style. In order to do this, he must set up his own personal, informal communications network without which he could not effectively accomplish his task.

Under wartime conditions, the informational problems are greatly multiplied. Reliable, unbiased and current information is difficult, if not impossible, to obtain. This necessary feedback is crucial to the proper development of the product. One way of obtaining such information is by means of a competent, on-the-spot, liaison officer who can obtain firsthand information on an informal basis and pass it quickly to the project manager. During wartime there is more reason to avoid error in the development cycle because there is less time available to rectify it. Under peacetime conditions, the reverse is true: there is more time available to develop a product, but the competition for the funds for its development is much fiercer. A major error or oversight during this phase of the cycle could result in the project's cancellation in favor of a more lucrative one.

The informal communicative process has been studied using examples of USAF R&D project managers. These examples have demonstrated not only the importance of informally received information, but also the results obtained through the use of informal communication. This was the basic intent of this paper, i.e., to show that informal communication is a vital aspect of the total USAF R&D project management process.

A process implies both an input and an output function. The total R&D project management process, is depicted by Figure 6. Thus, the information received informally is very important to the input portion of the process because of the vital part it plays in decision

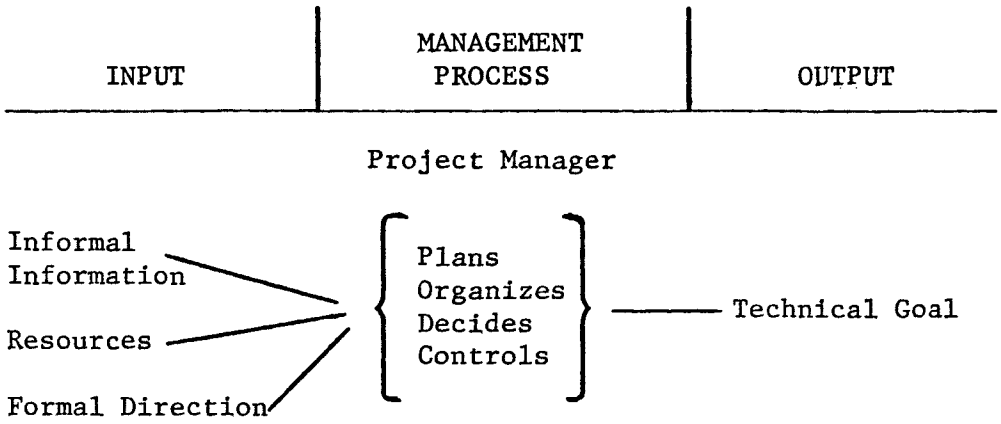

Fig. 6.--USAF R&D Project Manager Function

making, which in turn affects control. The control process is also achieved through informal communication. This is crucial to the quality of the technical product, that is, the goal. Thus, informal communication plays a vital part on both sides, as well as within the process itself.

The process of R&D project management is a complex one as each project is unique. The constraints attached to each project are variable and include items such as the difficulty and importance of the task itself. They include the quantity and quality of available technical expertise, the amount of funds allocated to accomplish the objective, and the time allotted for completion. In order to accomplish the task within these limits, it is absolutely necessary for the project manager to obtain the active cooperation and participation of people not under his direct, or even indirect, control. These task-oriented relationships established by the project manager can be practically maintained only by means of informal communications.

The principal task of the project manager is to achieve an objective within available or given resources. Implicit in this task is the assumption that the project manager has the requisite authority to perform all of the management functions. The result of the input and management process is the output or technical goal. The degree of achievement of this goal is a function of the control exerted by the project manager.

The USAF R&D project manager does not have the authority to formally direct his program. This authority is vested in the contracting officer (see Figure 3). Lacking formal authority to perform the control function of the management process, the project manager must exert informal leadership in order to attain his goal within the constraints of the allotted task. This leadership is asserted by means of informal communications, the channels of which provide the reins of control to the project manager, as well as the means to reach a valid decision. Thus, from every aspect of the USAF R&D project management process, informal communication is vital in order to successfully achieve the technical objective.

Appraisal of Findings

The establishment of the need for effective informal communications for the Air Force R&D project manager is based upon occurrences which are necessarily evaluated on a subject basis. One must take into account such things as personal relationships, interests, situational environments, needs, and a host of other factors, each of which had some bearing on a particular situation at a particular time. On the whole, these subjective evaluations have been found to be pertinent

and, more important, useful in today's complex technological environment. It should be emphasized that informal communication by itself is not and should not be construed as a panacea. Informal communication is valuable in addition to sound management practices. Tomorrow's technology will be more involved than is today's. One can expect, therefore, that the future project manager's task will involve more interrelations than in the past. These resulting interactions between the project manager and his contractual partners are, therefore, even more necessary than before.

In order for the USAF R&D project manager to accomplish his task, he must develop and effectively maintain a solid network of informal communicative contacts of which he is the center. To be successful, this duty and responsibility cannot be delegated.

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